EFFECT OF PROCESSING AND SUBSEQUENT STORAGE ON NUTRITION

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OBJECTIVE

- To determine the effects of thermal processing, freeze drying, irradiation, and storage time on the nutritional content of food
- > To evaluate the nutritional content of the food item currently used on the International Space Station and
- To establish the need to institute countermeasures
- * (This study does not seek to address the effect processing on nutrients in detail, but rather aims to pla in context the overall nutritional status at the time consumption)

BACKGROUNI

- Food products for space feeding systems are processed to commercial sterility
 While heat sterilization is the most effective food preservation process, it affects vitamin and protein quality ➤The dehydration process has the smallest impact on
- ➤ Micronutrient stability is dependent upon the composi
 - macronutrients matrix A kinetic model only provides an estimate of the remainutritional contents
- ■It is difficult to extrapolate between systems

 Food Composition Database does not take into account effects of processing

- Food with a 3-5 year shelf-life will be requi mission to Mars
- Nutrient loss during processing and sub can be significant
- Nutrition requirements are delivered via the food
- The quantity of nutrients, e.g. v ns, at consumption is
- Nutrients play a vital role in facilitating the capability of astronauts to tolerate physiological changes

 As mission durations increase, physiology changes gain Nutrients play a vital of astronauts to toler

DELIVERABLES

- Conduct a literature review to better understand the potential effects of retorting, freeze drying and irradiation on nutrient loss
- Determine the effect of processing on representative flight food products by comparing the calculated nutrition to the actual nutrition one month after processing
- Determine the effect of subsequent storage on nutrition by comparing the one month nutrition analysis results with those at 1 year and 3 years
- Determine the capability of the current food system to provide adequate nutrition for long duration missions

Exploring COUNTERMEASURES

- Optimization of process, packaging, and storage conditions for nutrient retention
- Exploration of alternative sterilization methods
- Maximization of available nutrients by reformulation using ingredients with dense intrinsic nutrients
- Treatments with food additives to provide nutrients, e.g.
- Fortification with stable nutrient forms, e.g. encapsulation, chelating, analogs, etc.
- Cultivation of quick growing fruits, vegetables, yeasts to deliver essential nutrients

RESEARCH PROTOCOL

- Ten to twelve processed selected per year for five vears
- Nutritional profile will be determined
- 1 month after processing
- 1 year after processing 3 years after processing
- Comparing
- calculated vs. analysis 1 month vs. 1 yr vs. 3yrs
- Until a need for countermeasures is established

10+/yr; over 5 yr One Year Final Report

Effect of Proc

- Nutrients which are sensitive to heat, light, oxygen, pH are easily destroyed during processing, e. vitamins C, B1 Losses are related to the total
- ergy input, physicochemic te of water terals are not significantly
- affected by processing, but bioavailability may change Relativity of nutrient retention Freeze-dried > Thermostab

	Vitamin C	U	U	U	8	U	U	
	Felic sold			U				
	Vitamin B1	U						
	Vitamin 02			3/		s		
	Vitamin B3							
	Dictin	U						
d	Vitamin E							
	Partothenic acid							
	Vitamio A					8		
	Vitamin D	U			s	s		

Nutrient Heat Light Oxygen pH pH pH c7 =7 >7

ect of Subs

- Nutrient changes in bioavailability Oxidation photochemical reaction
- complex formation decomposition Deterioration determined by:
- initial composition, e.g. crystalline & amorphous structure distribution & thermodynamic state
- of the water environmental factors.
- e.g. moisture, gases, temperature ■ barrier provided by packaging

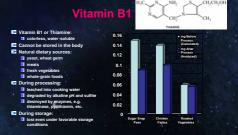


Vitamin C Vitamin C or Ascorbic acid: white, highly water-soluble 180 Humans cannot manufacture vitamin C 160 absence of L-gulonolactone oxidase 140 Natural dietary sources: 120 100 80 ■ During processing: ■ significant loss from chemical degradation 60 40 degradation under oxygen & anaerobic conditions leaching into cooking wate decomposed at 190°C

fresh fruits fresh vegetables
fresh meats

During storage:

UV degradation





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